Pt/SnO_2 CATALYSTS FOR NO DECOMPOSITION

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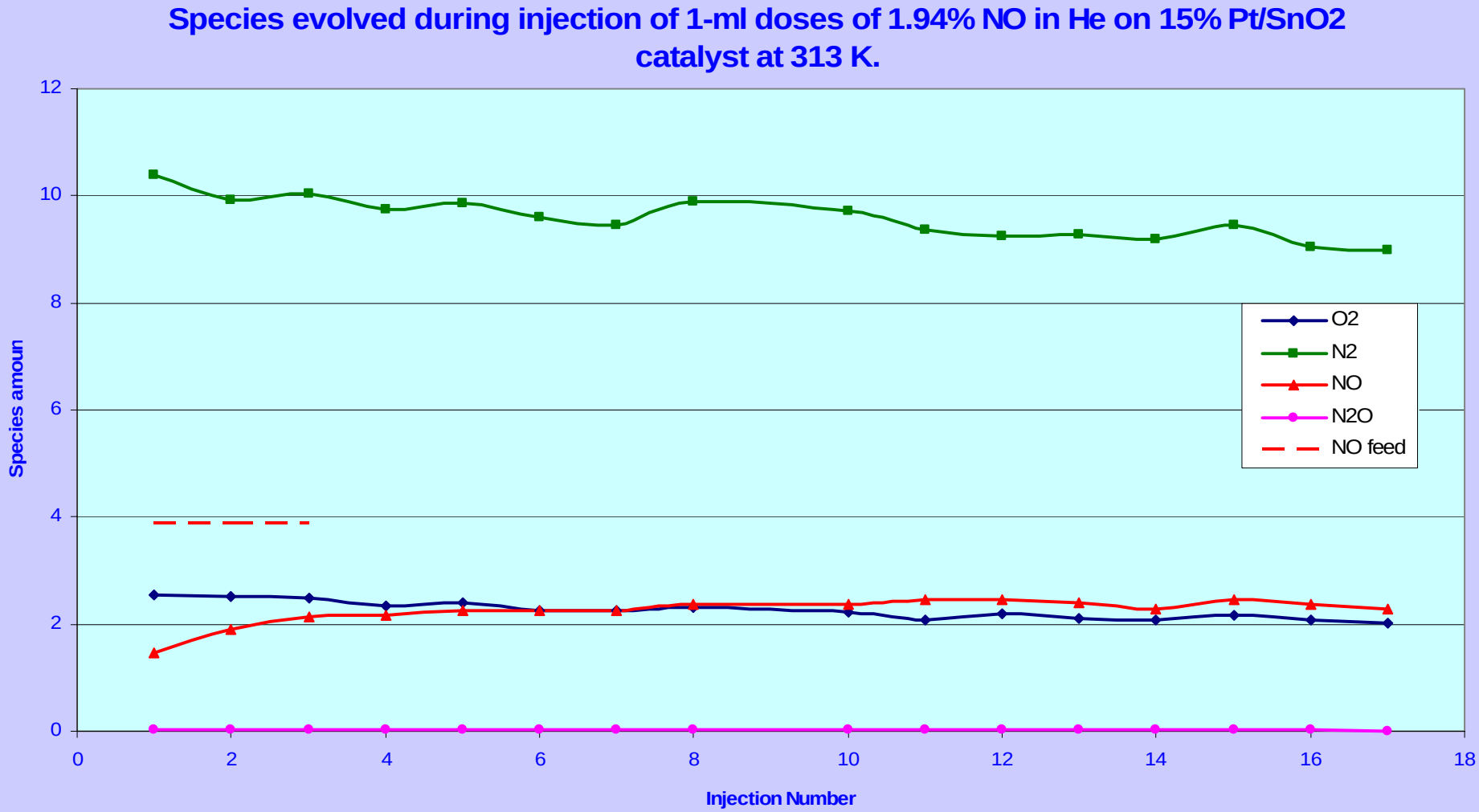
WHY Pt/SnO_2

The most promising decomposition catalysts are transition metal-exchanged zeolites, perovskites, and noble metals supported on metal oxides such as alumina, silica, and ceria. The main shortcoming of the noble metal reducible oxide catalysts is that they are prone to deactivation by oxygen.

WHY Pt/SnO_2

Catalysts containing tin oxide show oxygen adsorption behavior that may involve hydroxyl groups attached to the tin oxide. This observation leads one to believe that the Pt/SnO_2 catalysts may have a potential as NO decomposition catalysts in the presence of oxygen.

Temperature-Programmed Desorption Experiments



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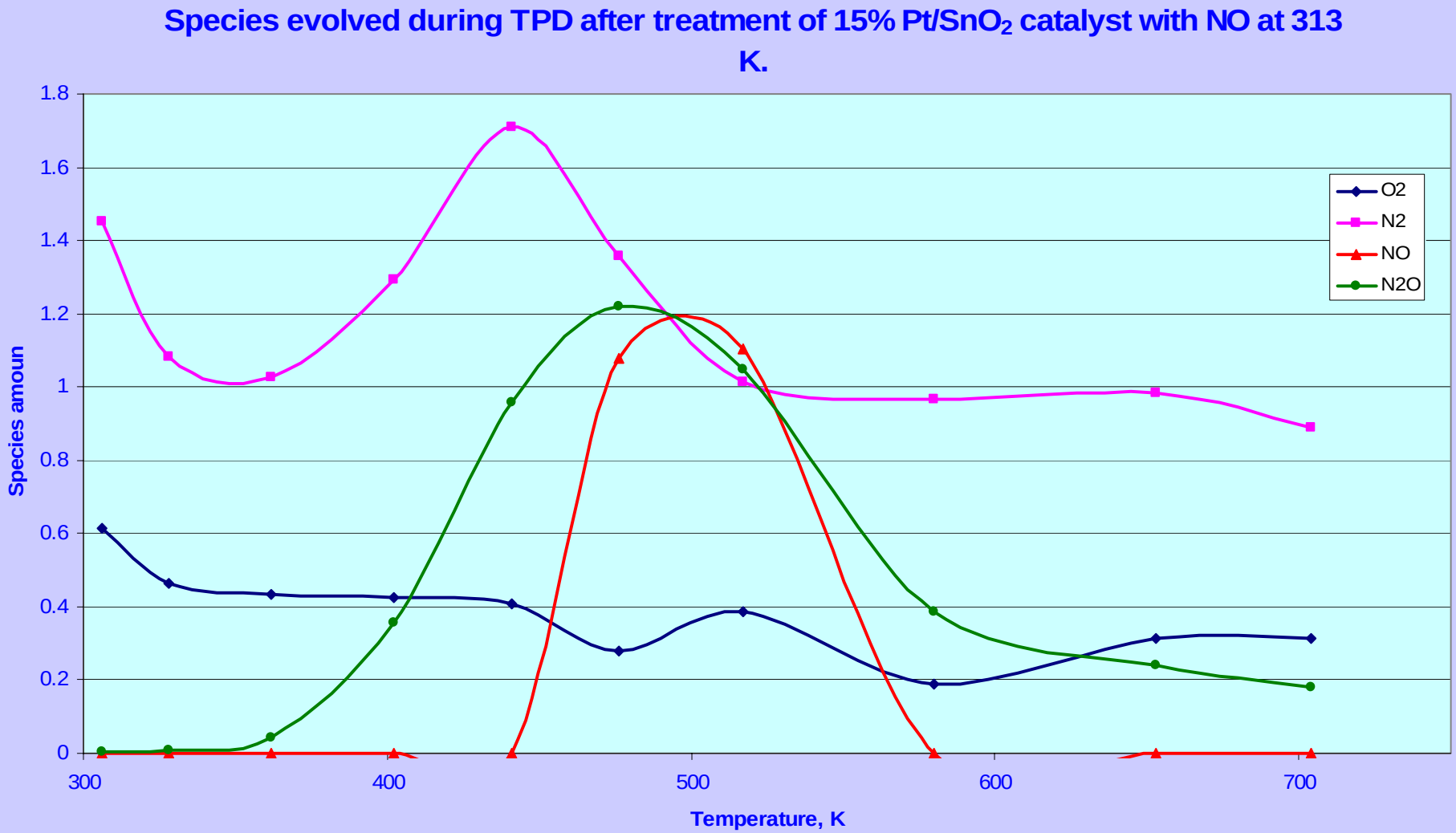

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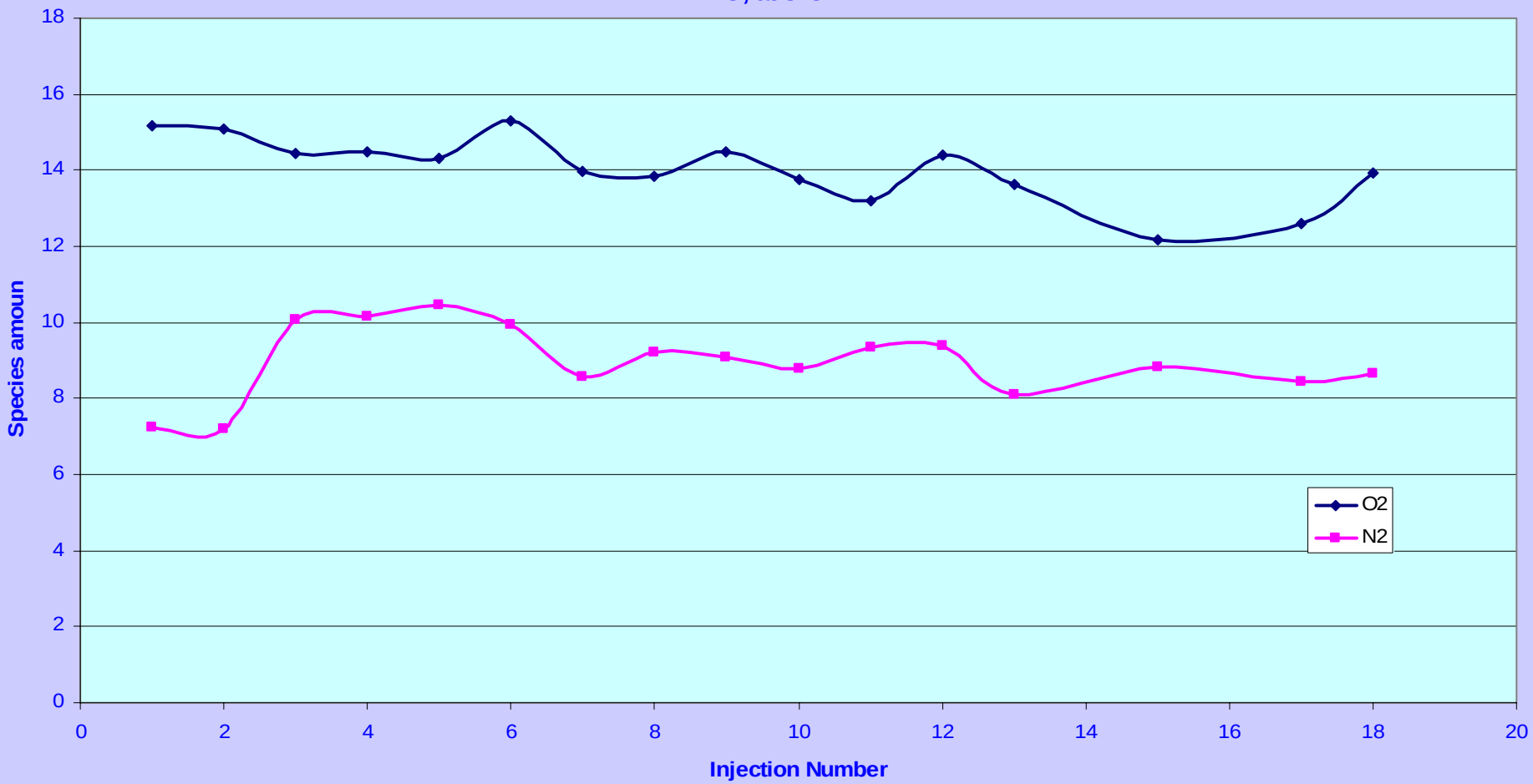

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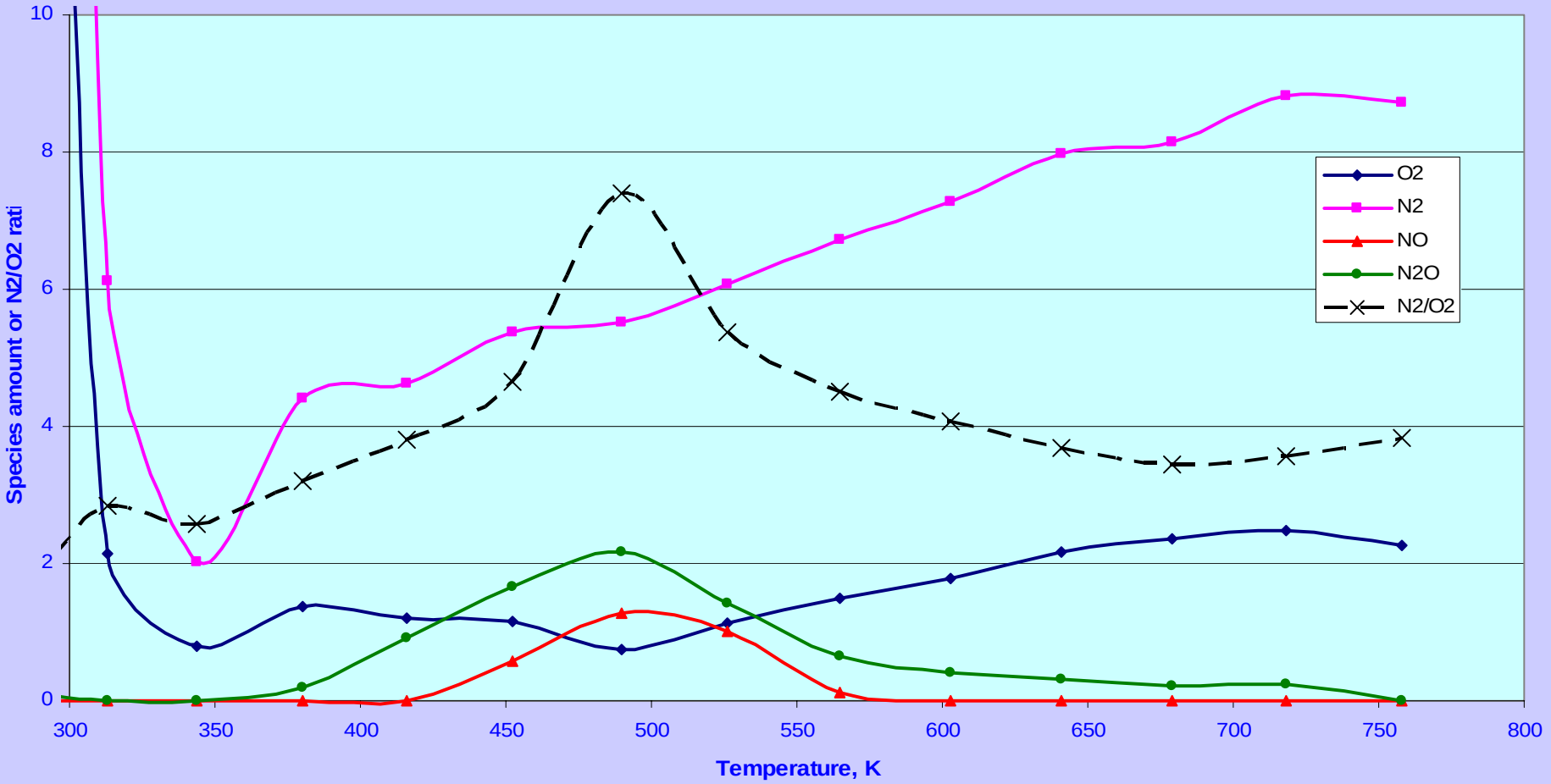


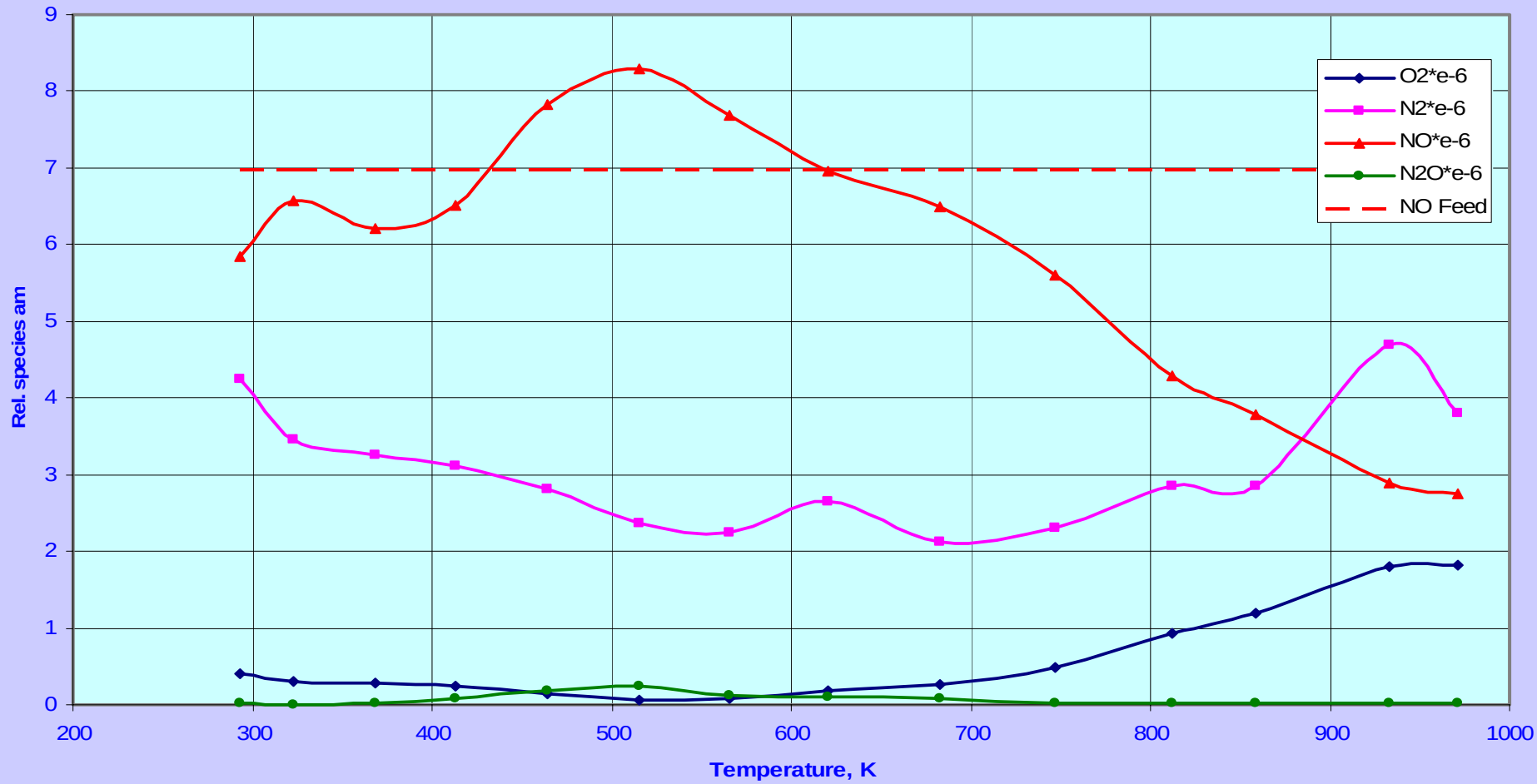
CONCLUSIONS: TP Desorption

- During pulse chemisorption, about half of NO is either dissociated into N_2 and O_2 or retained on the catalyst at a steady rate. Based on the N_2/O_2 ratio, the latter is deemed a more probable explanation.
- During TPD, the N_2, N_2O, and NO peaks were separated by about 25 K. There were two O_2 minima, one corresponding to the N_2O peak and the other to the termination of NO peak.
- The observed NO peak could be due to the presence of free surface nitrite or nitrate species, but the presence of N_2O_4 and N_2O_3 is more likely.

CONCLUSIONS: TP Desorption

- The 25 K separation between the N_2 and N_2O peaks suggests that these two species are produced , at least partially, by different surface reaction schemes.
- During the TPD after successive adsorptions of NO and O_2, the N_2O and NO peaks and the single O_2 minima were all observed around 490 K suggesting that in the presence of excess O_2, both N_2O and NO were produced by parallel surface reactions.
- Presence of excess oxygen increased the production of N_2O.

Temperature-Programmed Reaction Experiments



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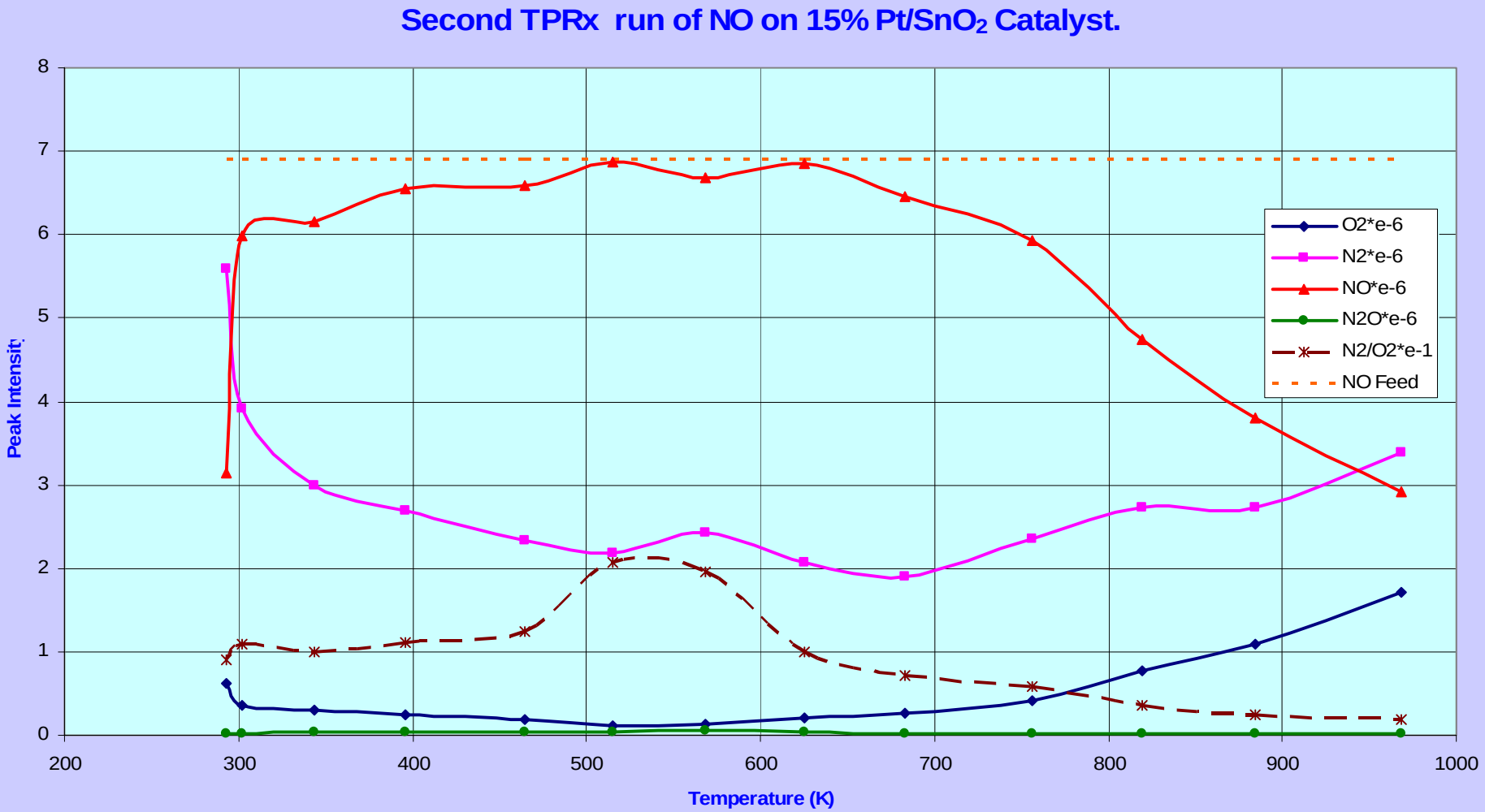

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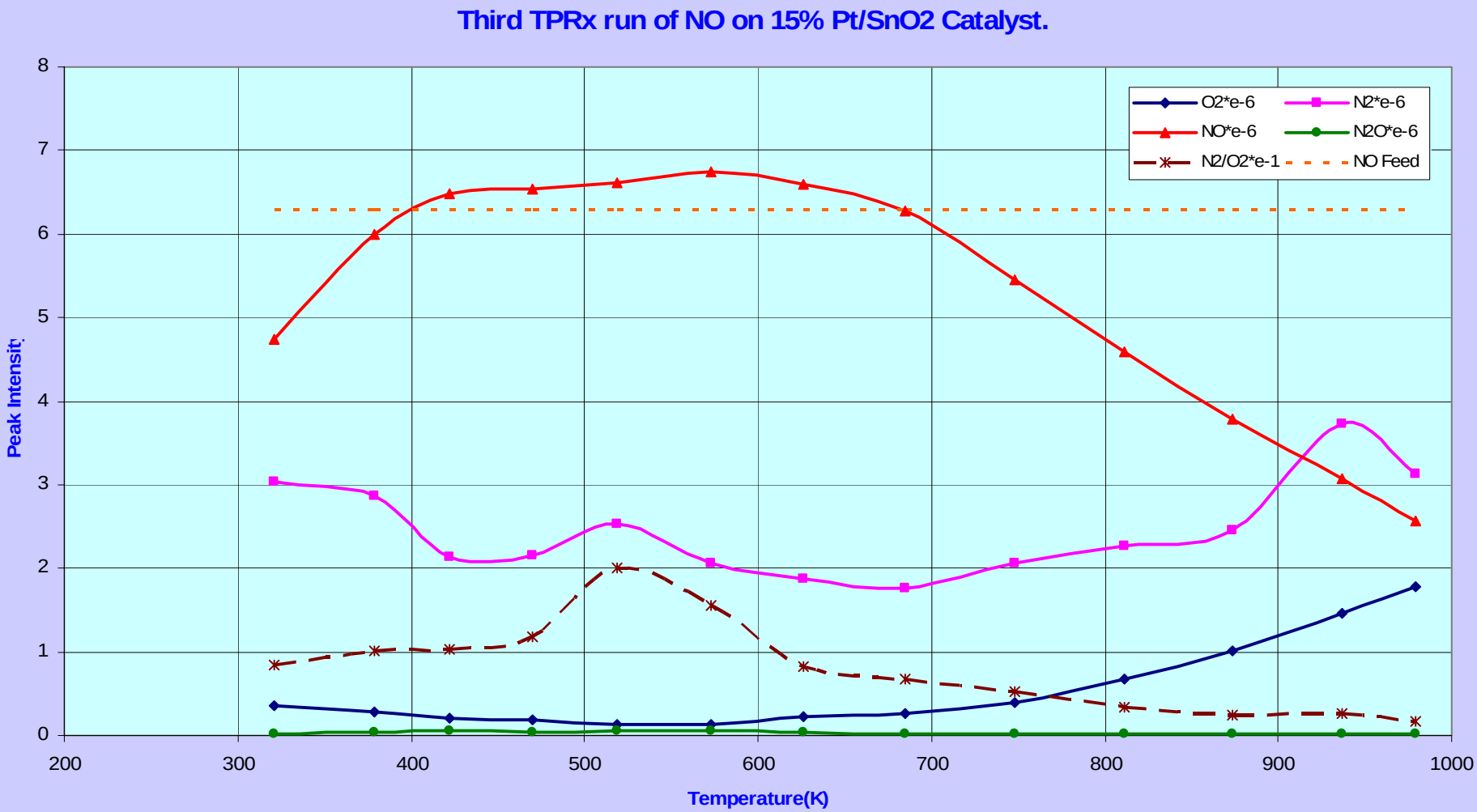

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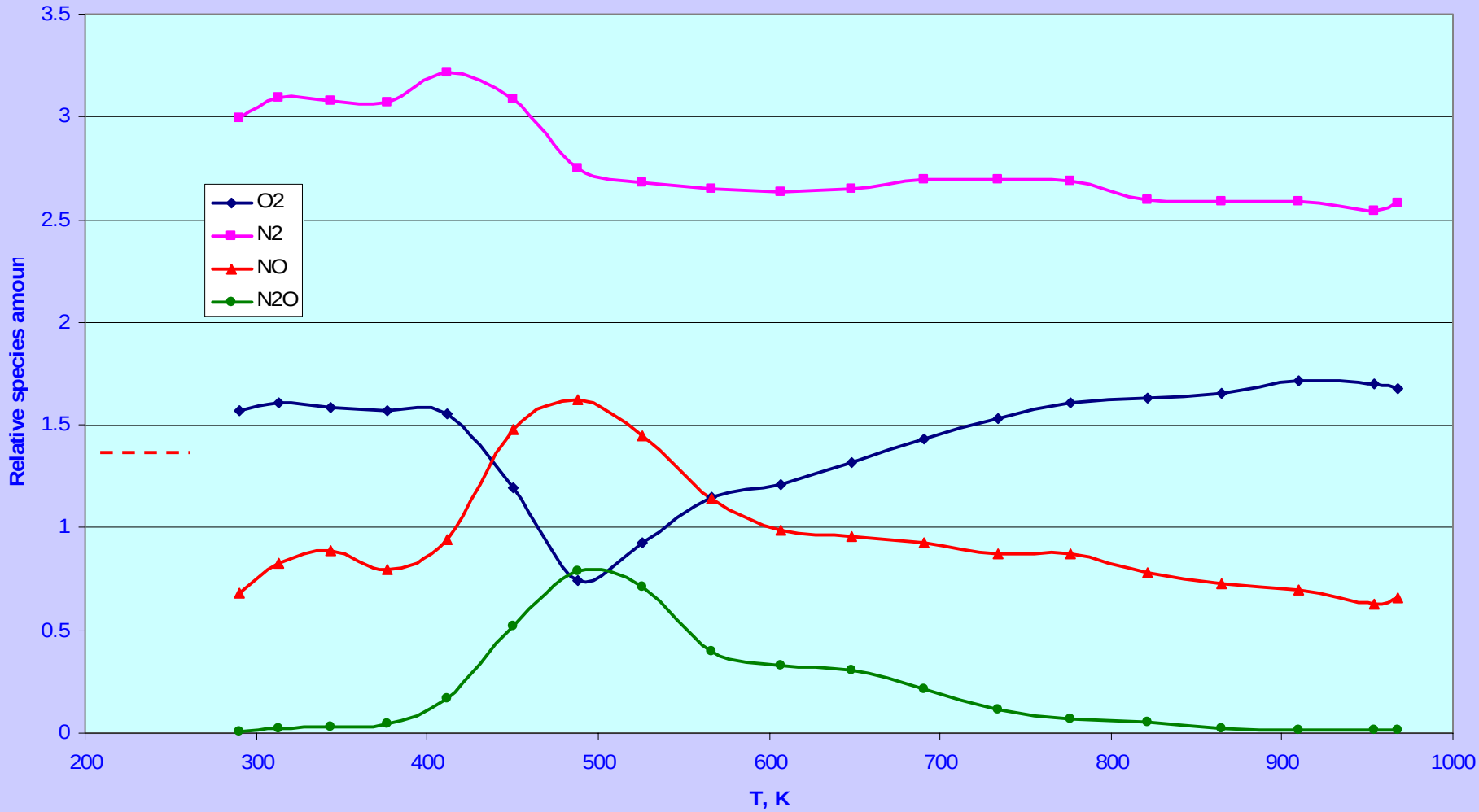

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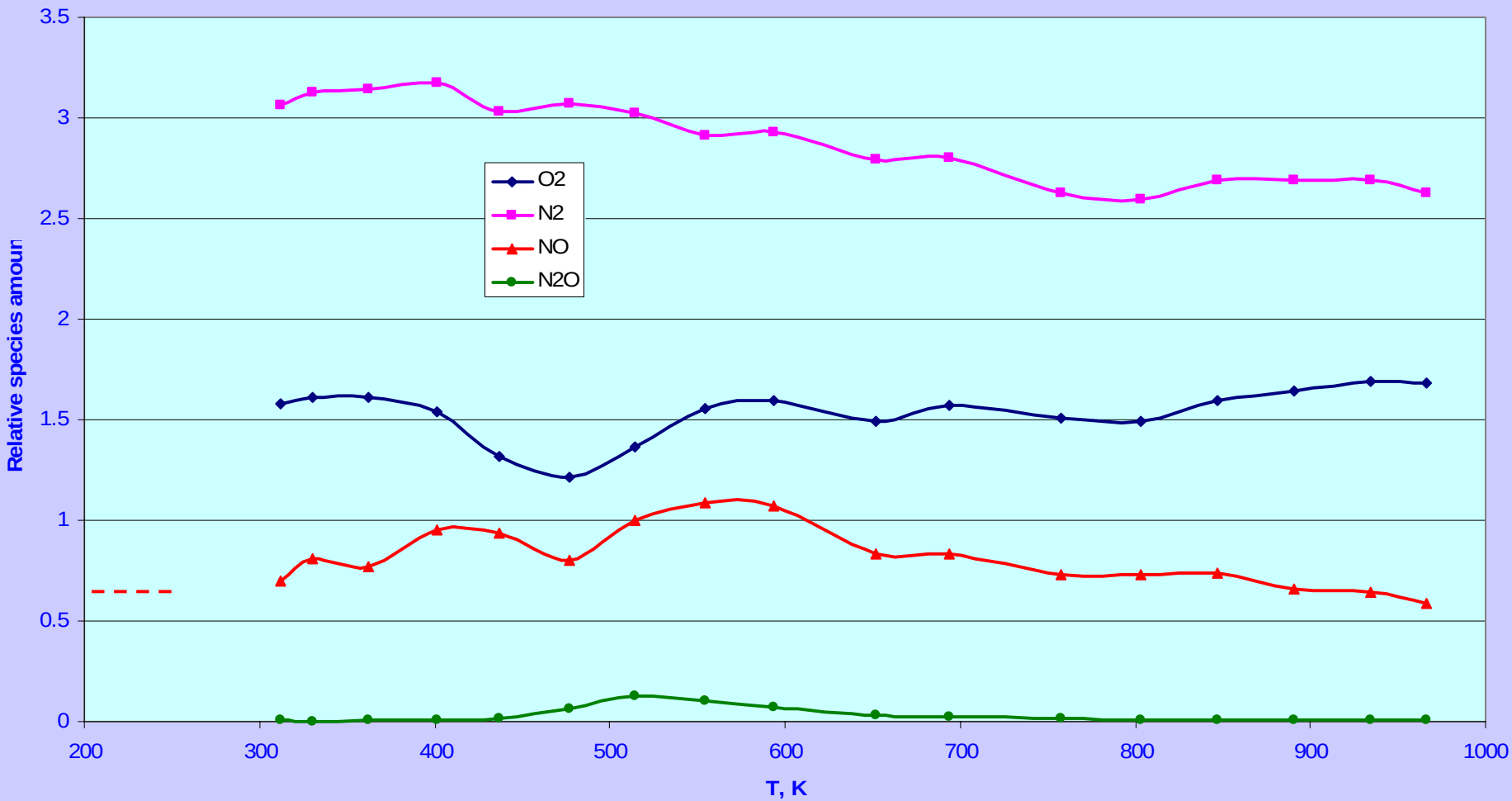

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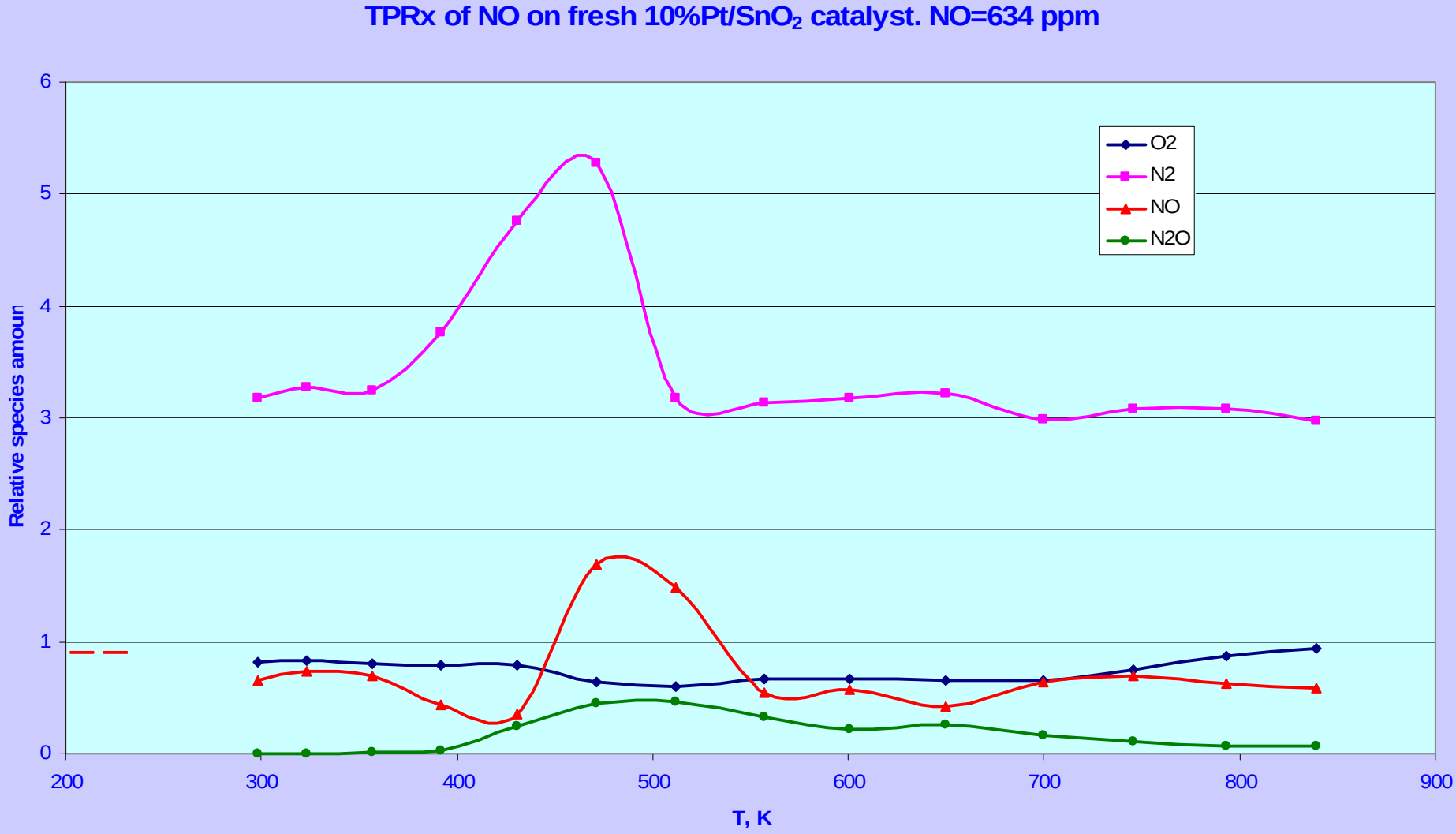

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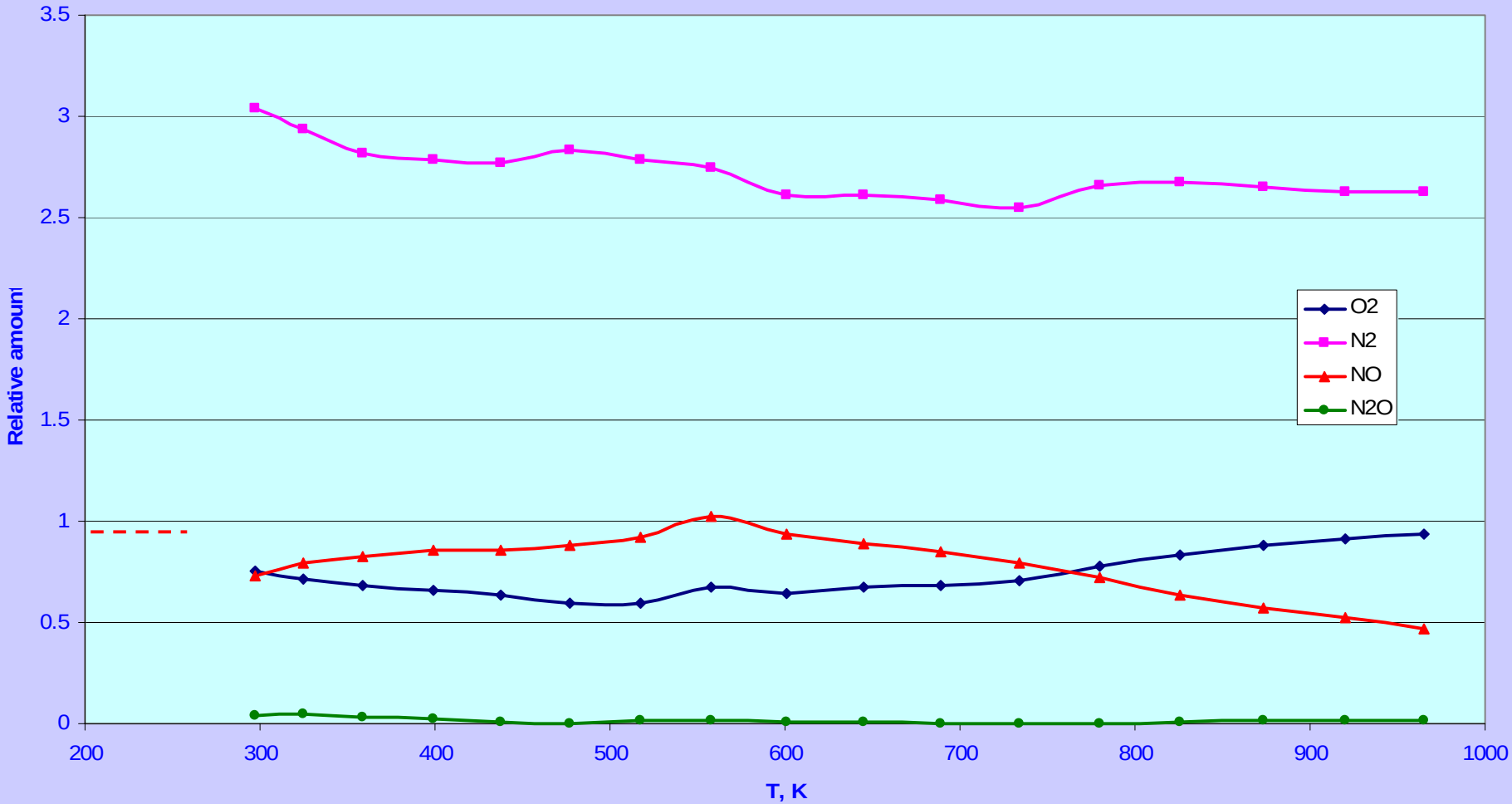

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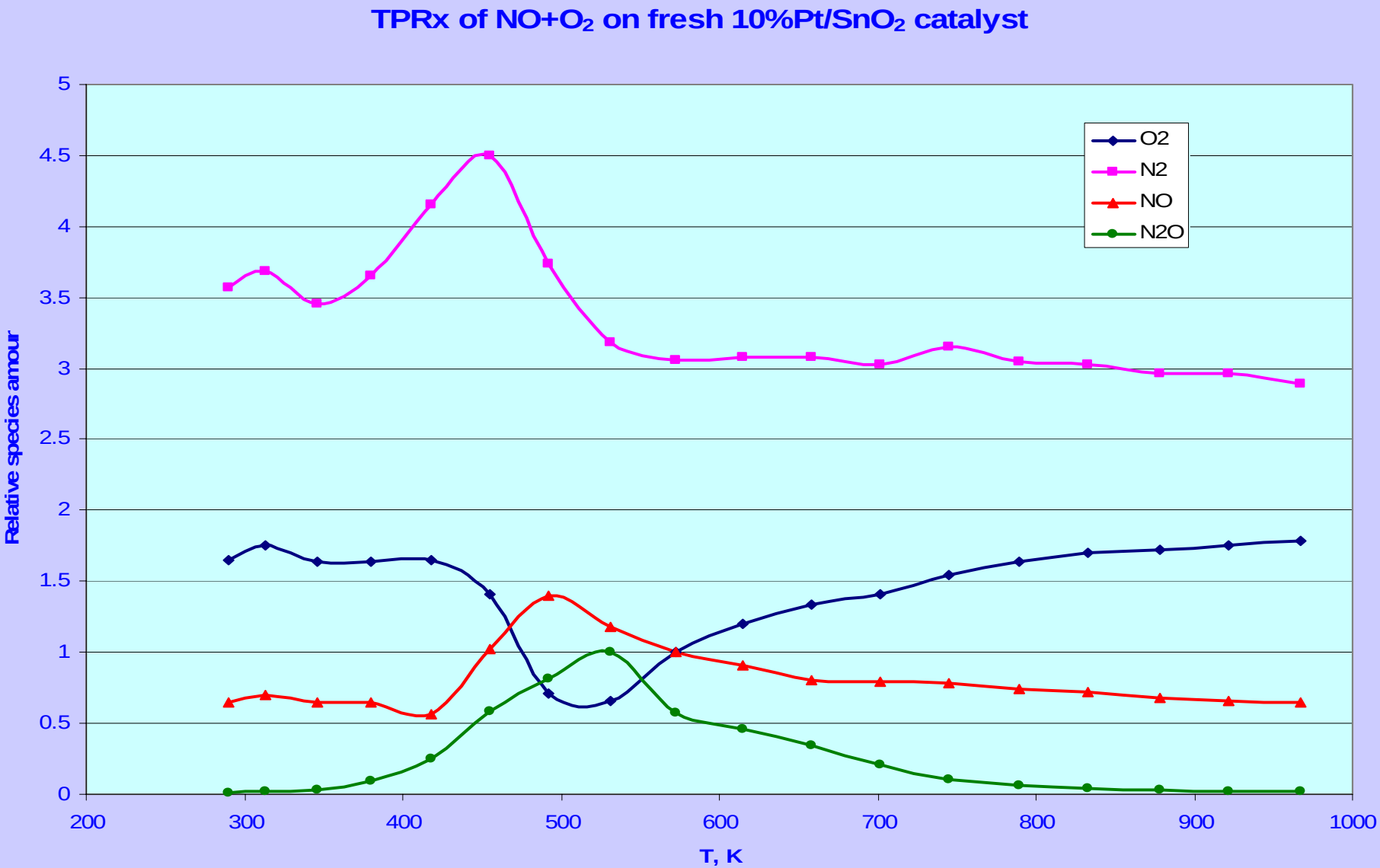

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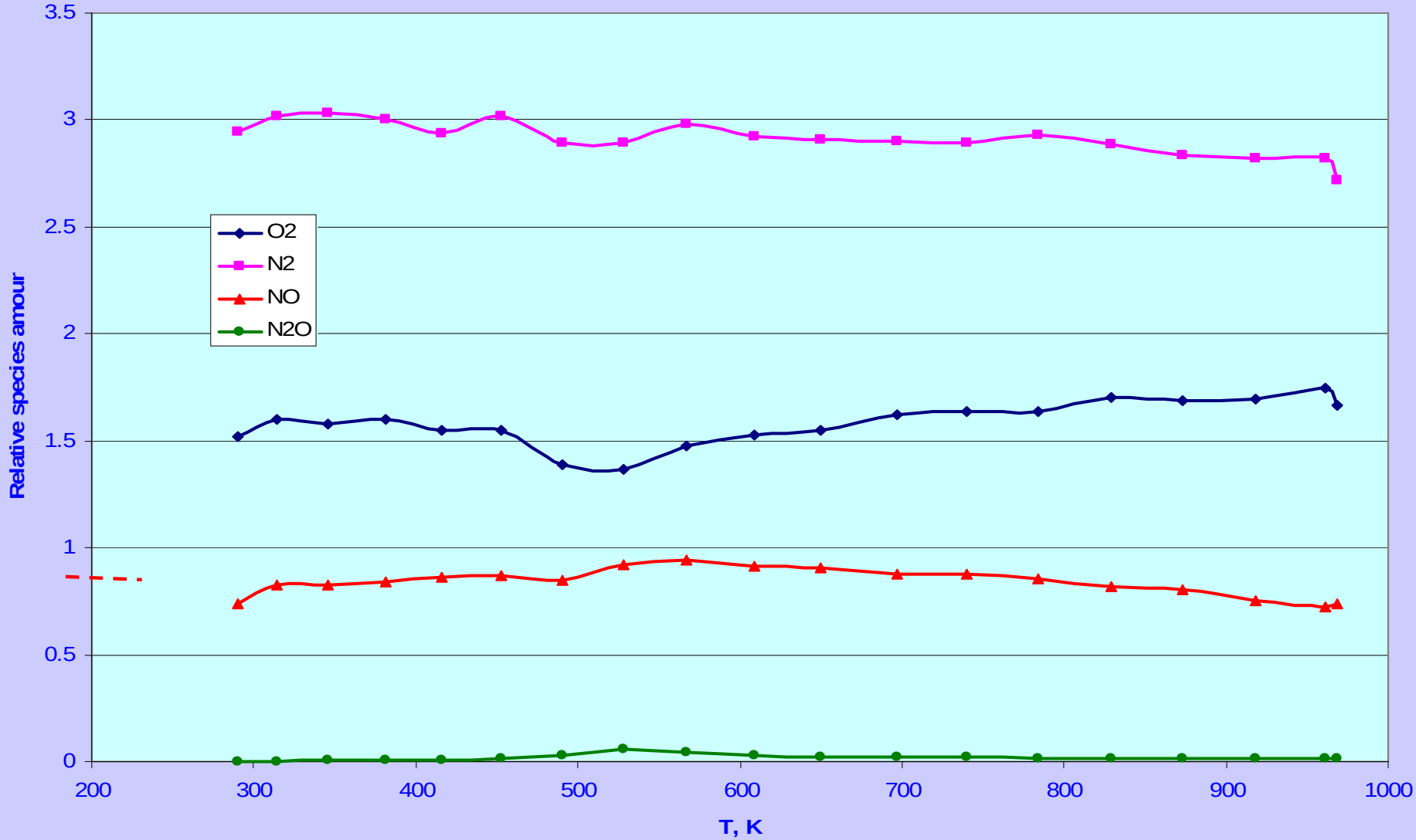

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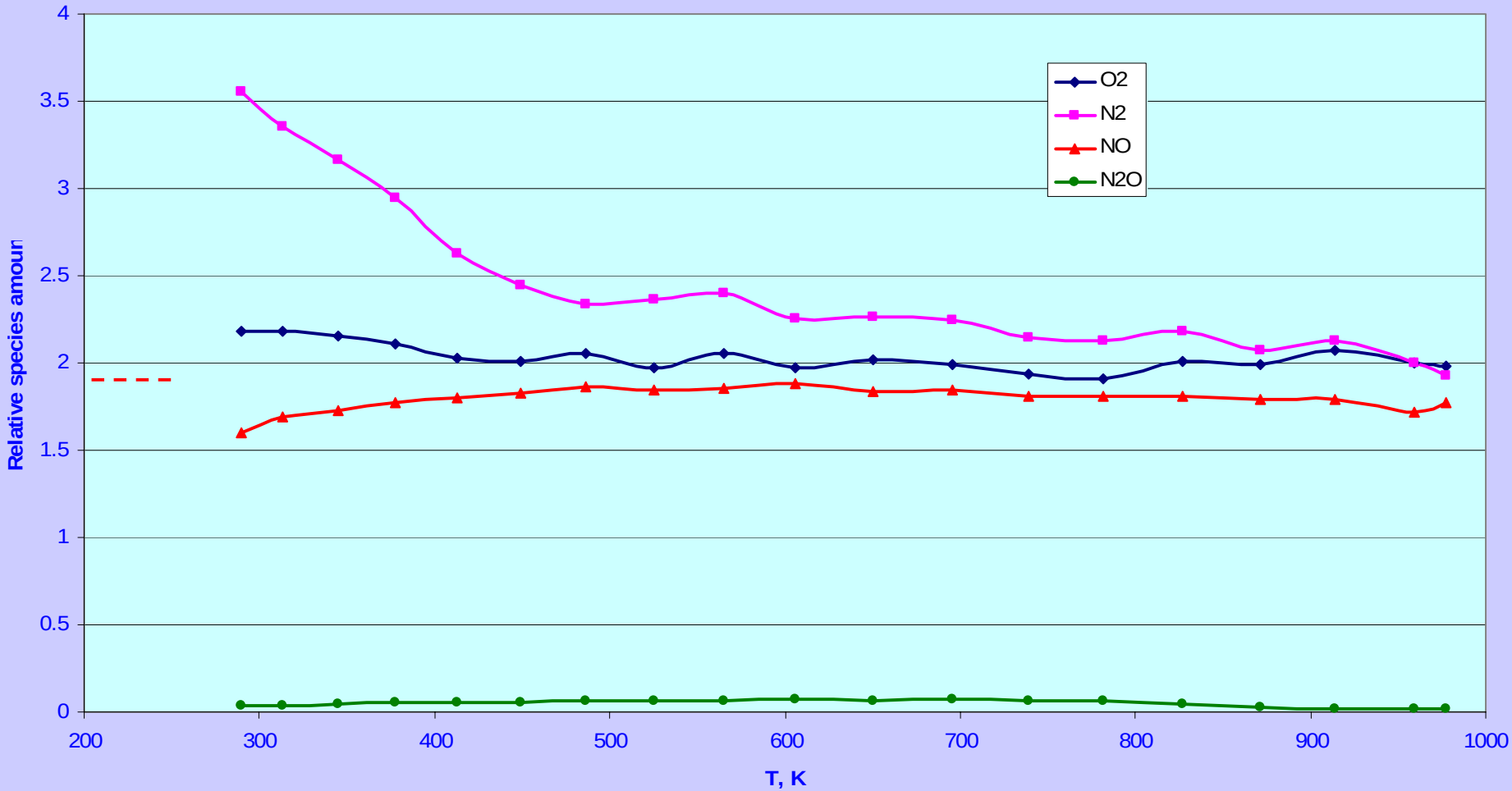

CONCLUSIONS: TP Reaction of NO

- There was no NO decomposition below 520 K, but some N_2O formation above 370 K, which peaked at 520 K, but no N_2O was present above 750 K. NO desorption started at 520 K and increased with temperature.
- The N_2O formation on the used catalysts was significantly smaller than that on the fresh catalyst.
- The start of NO decomposition is pushed to 625 K during subsequent runs with the same catalyst, but the rate is faster so that the NO concentration in the gas at 900 K is the same for fresh and used catalysts, which corresponds roughly to 50% conversion of NO.

CONCLUSIONS: TP Reaction of NO+O_2

- The presence of oxygen inhibits the decomposition of NO and promotes the formation of N_2O. On catalysts with 15% Pt, some decomposition activity starts around 425 K on fresh catalyst. During the second run NO decomposition does not start until 575 K. During the second run there was no NO decomposition activity up to about 550 K, but significantly less N_2O formation was observed.
- On fresh catalysts with 10% Pt, there was very little decomposition activity, but at lower temperatures N_2O was formed. During the second run NO dissociation activity increased and N_2O formation decreased.